

CHAPTER 7

ELECTRIC SHOCK

In the State of New South Wales, approximately thirty people die from electric shock annually, while countless others are injured to some degree. In some cases, this is brought about by lack of knowledge, while in others, sheer carelessness is the prime factor. The electrician must at all times be aware that he may be risking his life when working on an installation or equipment which has the capacity to deliver current. Maximum precautions should be taken to ensure that he does not receive injury while carrying out his work. Some useful hints to improve the electricians chances of survival in his chosen occupation are given in the first part of this chapter, while the steps to take in the event of the discovery of a victim of electric shock are listed in the latter section.

7.1 SAFETY FIRST

It is dangerous to work on any electrical system or equipment to which a supply in excess of 32 volts has been connected. This voltage connected to a circuit may be increased to a high value within an electrical system, the value being dependant on the components within the system. It is advisable to disconnect the electricity supply before attempting to work on any part of the system. Make sure the electrical supply is disconnected by applying the following rules.

- (a) Trace the circuit supply to its source.
- (b) Remove fuses or open isolating switch.
- (c) In the case of the isolating switch, tag the switch with the name of the person who opened the switch, the date and the time this occurred.
- (d) In the case of fuses, the electrician should take the fuses with him, so that they cannot be accidentally replaced.
- (e) Check the test lamp or meter at the source of supply, to ensure it is in working order.
- (f) Use the test equipment to check for power where the work is to be done.
- (g) Where there is no supply apparent, brush the back of the hand across the exposed part of the equipment before actually starting work.

It is important to apply this last test because test equipment can become defective at any time. If by chance the equipment is still 'live' and using alternating current, touching the exposed section with the back of the hand causes the muscles of the hand to contract. This forces the hand away from the 'live' equipment. If however, the 'live' equipment is grasped with the palm of the hand, the muscles contract and it becomes very difficult to release the hand, this often resulting in severe electric shock. Direct current tends to burn the skin and the area subject to injury may be minimised by again applying this last precaution.

WORKING CONDITIONS

- (a) Keep dry when working. The outer skin of the human body has a very high resistance when dry. This is greatly decreased if the skin is allowed to become wet.
- (b) Keep dry underfoot. The severity of the electric shock depends on the path the current takes through the body. Most fatal electric shocks occur when current passes from the upper part of the body through the torso of the feet, and then to ground.
- (c) Never work on 'live' equipment alone. Accidents will happen. The presence of somebody in the vicinity who can safely remove a person suffering electric shock may well save that person's life.

7.2 APPARENT DEATH

Prompt action is essential if a person who has stopped breathing is to be revived. The following procedure has been laid down by the Central District Ambulance Brigade of N.S.W., and all people should make themselves familiar with its application.

(a) ARTIFICIAL RESPIRATION

When breathing has ceased, the rescuer must breathe for the victim either by mouth to mouth, or mouth to nose.

1. Lay the victim on his back
2. Clear his airway, empty mouth with finger or cloth.
3. Put the head in the 'sniffing air' position, this opens the airway behind the tongue.
4. Pinch his nostrils together.
5. Blow down the mouth until the chest rises - if it does not rise re-check the head position - tilt the head further back.
6. Remove your mouth and watch the chest fall.
7. Continue - if the chest rises and falls the airway is clear and air is reaching the lungs.

POSTURE THE VICTIM'S BODY

The victim is placed rigidly on his back on the firmest surface immediately at hand. The slope of the body is not of great importance but it should be slightly head down.

CLEAR THE VICTIM'S AIRWAY

The rescuer quickly kneels on either side of the victim's neck and with the fingers of either hand removes any foreign material or loose objects from the mouth and back of the throat. As the airway is cleared, the head of the victim may be turned on either side.

POSTURE THE VICTIM'S HEAD AND SEAL THE NOSTRILS

Assuming a position on the right side of the victim, the rescuer places the opened palm of the left hand on the top of the victim's head and pushes it firmly back into the extended 'sniffing air' position. In this position the victim's mouth is likely to fall open slightly and his neck will be put on the stretch. The nostrils of the victim are sealed with the thumb and index finger of the left hand while the extended position of the head is maintained with the inside of the left forearm. A support under the shoulders makes it easy to keep the victim's head extended. The rescuer's right hand cannot always be used to give such support as it may be needed to check the pulse or support the victim's lower jaw. There should never be any delay to put something under the shoulders and the victim's head must at all times touch the ground.

DOES THE VICTIM BREATHE? IF NOT, INFLATE THE VICTIM'S LUNGS

The rescuer quickly leans over the victim's head, takes a deep breath in, opens his mouth widely and places it firmly over the victim's slightly open mouth. The rescuer then blows down the mouth until the chest rises for a distance equal to a normal inspiration. If the lips of the victim are not apart they should be separated with the right hand.

In cases where the victim is making weak breathing movements which are not sufficient to take air, containing oxygen, to the blood in the lungs, or when after breathing into the victim for some time he commences weak breathing movements, watch the chest closely and assist with further breath to complete the expansion of the chest.

DOES THE HEART BEAT? CHECK THE CIRCULATION IMMEDIATELY

Place the pads of the fingers of the right hand in the groove between the voicebox and the muscles of the neck at the level of the Adam's Apple. Press backwards to feel the artery. If a pulse can be felt the heart is still beating. If a pulse cannot be felt, quickly lift the upper eyelid of the victim's left eye. If the pupil is large and not reacting to light and if the pulse cannot be felt at a second attempt, the heart has stopped and external heart massage must be started immediately.

(b) EXTERNAL HEART MASSAGE (Called External Cardiac Massage or E.C.M.)

The heart is in the centre of the chest between the breast bone in front and the backbone behind. When pressure is applied to the lower half of the breast bone the heart is compressed, and blood is squeezed out into the arteries. When the pressure is released the breast bone springs forward into place, the compression ceases and blood flows from the veins into the heart. The valves prevent blood coming back from the arteries. The rhythmical application of pressure in this way produces an artificial pulse in the arteries and circulates blood to the tissues.

These directions apply no matter what the age, sex, size and build of the victim. Contact is made with the lower half of the breast bone with 2-3 fingers in an infant, with the heel of one hand in a child and with the heels of 2 hands, one on top of the other, in an adult. The rescuer must not dig the fingers into the victim's chest. Sufficient backward pressure is exerted over the lower half of the breast bone to depress it $\frac{1}{2}$ in. in an infant, 1 in. in a child and 2 in. in an adult. To do this with ease in an adult, the rescuer should lean directly over the chest holding the elbows straight, but this is not required for infants or children as little force has to be exerted on them. As soon as the breast bone is depressed the suitable distance, it is allowed to spring forward into place. The hands or fingers need not be removed from the chest of the victim.

Intermittent pressure is applied in this way about 60 times each minute.

(c) IF THE HEART IS NOT BEATING GIVE EXTERNAL HEART MASSAGE TOGETHER WITH EXPIRED AIR BREATHING

If Alone: Place the heels of the hands one on top of the other over the lower half of the breast bone, lean vertically over the victim's chest without altering the kneeling position, and give 15 rapid compressions. Return to the victim's face and give two expired air breaths. This sequence of 15 chest compressions and two expired air breaths should be repeated 3-4 times each minute. This in effect, will provide an artificial pulse rate of 45-60 beats/minute and an artificial respiratory rate of 6-8 breaths/minute.

If Two Rescuers are Available: One rescuer should oxygenate the lungs by clearing the victim's airway and if necessary, by giving E.A.R. The other rescuer assesses the circulation as already described and, if necessary, gives E.C.M. When E.A.R. and E.C.M. are applied simultaneously by two rescuers, the rhythmic depression of the sternum is restricted to the deflation phases of artificial respiration, i.e. each lung inflation is followed by 5 chest compressions. The inflation phase should last 1-2 seconds, the deflation phase 3-4 seconds and the whole sequence should be repeated 12 times per minute. When applied in this way, E.C.M. does not interfere with the effectiveness of E.A.R.

GENERAL

Remember, speed is essential if a person stops breathing. A person whose heart is in ventricular fibrillation due to electrocution may die within three minutes due to non circulation of the blood. Even though he may be in this condition, blood can be forced from the heart, by heart massage. In general it is well to remember the four fives.

1. 5 minutes to start
2. 5 good breaths
3. 5 compressions to one inflation
4. 5 seconds pause

TUTORIAL 1.7 (Revision)

- (1) Calculate the current drawn from an electrical supply by a 6.5 kW element whose resistance is 50 ohms.
- (2) A mass of 2000 kg is lifted 100m by a hoist. Calculate the work done on the load.
- (3) Determine the current drawn from a 240 volt d.c. supply by a 25 ohm resistor.
- (4) Calculate the power required to raise a load of 1500 kg through a height of 50 metres in 5 minutes.
- (5) Determine the power consumed by an element whose resistance is 80 ohms if the element draws 10 amperes from an electrical supply.